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Written by: J. Chaput

Table of Contents

1. Introduction
2. Identification
3. Life History
4. Monitoring
5. Management Strategies
    1. Sanitation
    2. Tolerant Varieties
    3. Crop Rotation
    4. Weed Management
    5. Pest Control Products
    6. Biological Control
6. Acknowledgements
7. For more information...

Introduction

Several species of leafminers may attack a wide range of vegetable and ornamental crops in the field and in the greenhouse. Typical mining damage to the leaves of tomato, cucumber, celery, lettuce, beets, Asian greens, potato, peas, beans, melons, cole crops, eggplant, pepper, onions, leeks, okra, spinach, chrysanthemum, gypsophila, gerbera, ageratum, marigold, aster, petunia, zinnia, snapdragon, calendula, dahlia and several others is characteristic. See Figures 1-6.

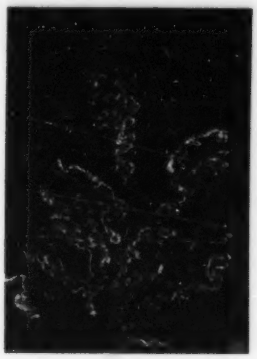

Figure 1. Leafminer damage on chrysanthemum leaf

Figure 2. Leafminer damage on greenhouse cucumber leaf

Figure 3. Leafminer damage on greenhouse tomato leaf

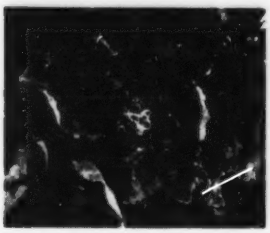

Figure 4. Leafminer damage on beet leaf

Figure 5. Leafminer damage on celery

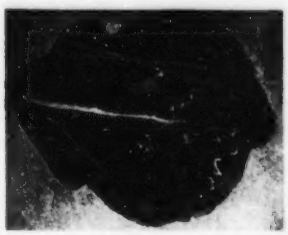

Figure 6. Leafminer damage on gai lan (Chinese broccoli)

Leafminers are small (2 - 3 mm), shiny black and yellow flies which lay their eggs into leaves so that the larvae feed between the leaf surfaces. Feeding punctures and egg-laying punctures may also cause serious damage in some cases. See Figures 7-9. The larvae of leafminers usually mature in the leaf and then drop to the ground to pupate. There may be several generations per year, however these leafminers are not known to overwinter in Canada except in greenhouse environments.

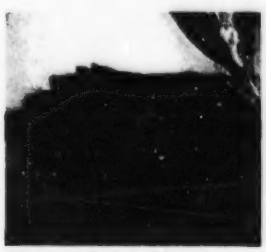

Figure 7. Leafminer stippling damage on celery

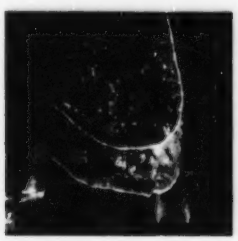

Figure 8. Leafminer stippling damage and adult leafminers on spinach

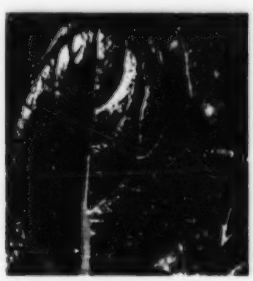

Figure 9. Leafminer stippling damage on yow choy

Severe damage to leaves can reduce the photosynthetic ability of plants and cause cosmetic damage to both vegetables and ornamentals.

| Top of Page |

Identification

There are 4 main species of leafminers which may attack vegetables and ornamentals in North America. Identification of the species may be difficult since they are very similar in appearance and behaviour. Leafminers are flies in the order of insects called *Diptera*. The 4 main species are *Liriomyza trifolii* (Burgess) (unofficial 'serpentine' leafminer), *Liriomyza brassicae* Riley (official 'serpentine' leafminer), *Liriomyza sativae* Blanchard (vegetable leafminer) and *Liriomyza huidobrensis* (Blanchard) (pea leaf miner). The chrysanthemum leafminer, *Chromatomyia syngenesiae* Hardy, has little pest status in Canada compared to other leafminer species.

All of these flies are similar in appearance with varying degrees of black and yellow markings. *Liriomyza sativae* (vegetable leafminer) is shiny black on its upper surface and the area between the eyes is yellow whereas the area just behind the eyes is black.

Figure 10. Adult *Liriomyza sativae* (vegetable leafminer)

Liriomyza trifolii has a more grayish upper thorax because this species has more bristles and the area behind the eyes is mostly yellow.

Figure 11. Adult *Liriomyza trifolii* (unofficial 'serpentine' leafminer)

Liriomyza brassicae is very similar in appearance to *Liriomyza sativae* and can only be distinguished by dissection of the male genitalia by an experienced entomologist. *Liriomyza huidobrensis* (pea leaf miner) is a slightly larger leafminer fly and is normally a darker colour overall with a more pale yellow colour than the other species.

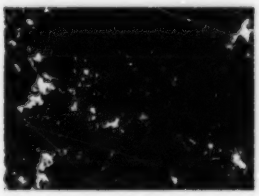

Figure 12. Adult *Liriomyza huidobrensis* (pea leafminer)

One key distinguishing feature of the pea leafminer is the larvae's behaviour in the leaf. The mines of the pea leafminer tend to be more visible from the lower leaf surface and around leaf petioles, whereas the mines of the other species are more visible from the upper leaf surface.

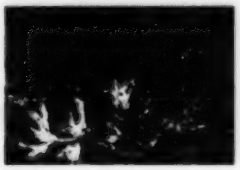

Figure 13. Damage to celery typical of *Liriomyza huidobrensis*

The larvae of leafminers are small maggots which are pale yellow.

Figure 14. Leafminer larva

| Top of Page |

Life History

All of the leafminer species have a similar life history, however the pea leafminer takes slightly

longer to develop. The eggs are laid in the leaves and oviposition punctures themselves can be observed and are called 'stipples'. Optimal temperatures for feeding and egg laying range between 21°C and 32°C. Egg-laying is reduced at temperatures below 10°C. After 2 - 3 days of incubation, the eggs hatch.

Larvae tunnel within the leaf tissue forming the characteristic mines, then cut a semi-circular opening in the tissue and drop to the soil to pupate. If temperatures are warm, larvae can reach maturity in 4 - 6 days and the pupal stage lasts another 4 - 7 days during the summer.

Pupae can survive for up to 90 days when temperatures are cool or host plants are not available. The life cycle could be as short as 14 days at 30°C or as long as 64 days at 14°C. Mating, egg-laying, larval emergence from leaves and adult emergence from pupae tends to occur mostly in the morning, depending on temperature and cloud cover.

| Top of Page |

Monitoring

In all crops, watch carefully for the presence of adult leafminer flies, mined leaves and make careful note of problem areas. In field vegetables, sticky traps or sweep nets can be used to monitor adult flies, however the number of adult leafminer flies does not necessarily correlate to leaf damage. In greenhouse crops, where use of biological control is prevalent, commercially-available natural enemies are released at the first sign of mining in the leaves so regular and consistent monitoring of the crop is necessary.

Thresholds for leafminers on field vegetables are not established, however relatively high numbers of flies and mines in leaves are needed to cause severe economic damage. The exception to this is in the floriculture industry where leafminer damage directly effects the marketable portion or in vegetable crops where the leaves are sold as part of the marketable portion, i.e. spinach, beet greens, Asian greens, lettuce and leeks.

| Top of Page |

Management Strategies

Sanitation

Remove all plant debris and weeds from the greenhouse. Begin cleanup immediately following harvest and dispose of debris as far as possible from the growing area. Totally cover or bury debris to reduce the dispersal of any emerging leafminer flies. Consult OMAFRA Factsheet, Sanitation Recommendations for Management of Insect and Mite Pests of Greenhouse Vegetables *(Order No. 94-029)*. In field vegetables, cultivation of crop debris or removal of infected plant material from fields is recommended. Monitor greenhouses close to field vegetable growing areas as potential sources of leafminer.

| Top of Page |

Tolerant Varieties

Avoid chrysanthemum varieties which are highly susceptible to leafminer infestations. Most greenhouse tomato varieties are similarly susceptible, however some cherry varieties are more susceptible than most others. If susceptible varieties have to be grown, it is recommended they be grown in isolation. In field vegetables, there is little information about leafminer tolerance. Degrees of infestation vary with the type of crop, neighbouring crops, weeds, temperatures and leafminer species.

| Top of Page |

Crop Rotation

Crop rotation is an effective pest management tool. Alternating leafminer susceptible crops with leafminer resistant crops reduces the population. Leaving greenhouses empty during the winter also reduces leafminer populations, however this is not always practical or economical. Crop rotation in field vegetables is always recommended for this and many other pests.

| Top of Page |

Weed Management

Many wild plants act as hosts for leafminers. Maintaining weed free conditions both in the greenhouse and the field is recommended.

| Top of Page |

Pest Control Products

Few pesticides are labeled for control of leafminers in Canada. Leafminers are known to develop resistance to insecticides quite quickly. When available, always rotate between insecticide groups. Most effective control is obtained with systemic or translaminar products which target the larvae. Thorough coverage of the crop is essential for effective leafminer control. A minimum of 2000 L of water/ha is recommended for spray applications.

Time insecticides to have the most impact on susceptible stages. Based upon what is known already, sprays applied early in the morning should be most effective. Spraying should only be based upon regular and consistent scouting information.

For more information consult OMAFRA Publication 363, *Vegetable Production Recommendations* (Click here to order), Publication 371, *Growing Greenhouse Vegetables* (Click here to order), and Publication 370, *Production Recommendations for Greenhouse Floriculture* (Click here to order).

| Top of Page |

Biological Control

The parasitic wasps *Diglyphus isaea* (see Figure 15) and *Dacnusa sibirica* (see Figure 16) are available for control of leafminers in greenhouse crops. Generally, *Diglyphus* works better in the summer, whereas *Dacnusa* works better in the winter. These parasites will not be effective in field vegetables, however there may be natural parasites present that can reduce the population.

Figure 15. Parasitoid *Diglyphus isaea*

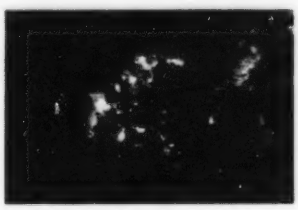

Figure 16. Parasitoid *Dacnusa sibirica*

| Top of Page |

Acknowledgements

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| Top of Page |

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| Top of Page |

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